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PHYSIOTHERAPY IN DOGS WITH HIP OSTEOARTHRITIS – EFFECTS ON PAIN, MUSCLE AND LAMENESS: A RANDOMISED CONTROLLED TRIAL

ORIGINAL ARTICLE

ABSTRACT

Purpose: The aim of this study was to investigate the effectiveness of a physiotherapy programme in dogs with hip osteoarthritis (OA).

Methods: 20 dogs with hip OA were included in the four-weeks study. The dogs were randomly divided into two groups as physiotherapy group (PTG) and control group (CG). Hyaluronic acid (HA) was injected into the hip joint of dogs in PTG and CG. The physiotherapy programme in PTG consisted of massage, electrophysical modalities and exercises. Primer assessments were pain intensity, muscle mass and lameness scores. Pain assessment was performed with Simple Pain Rating Score (0-4). Muscle mass was measured by thigh circumference measurement and lameness was measured by scoring system (0-5).

Results: At the end of the study, pain intensity (p=0.006) and lameness scores (p=0.005, p=0.006) were decreased and muscle mass was increased in the PTG (p=0.012). In addition, between group comparisons showed that all changes were statistically improved in the PTG compared to the CG (p=0.042, p=0.010, p=0.028, p=0.015).

Conclusion: We think that the "HA + physiotherapy" programme used in our study is more effective than "HA alone" in reducing pain and increasing muscle mass. Therefore, we can say that physiotherapy programmes are beneficial and safe in the treatment of dogs with OA. Physiotherapy programmes can be used to prevent the development of muscle atrophy and lameness, especially from the early stages of the disease.

Keywords: Animal Physiotherapy, Dog, Muscle, Osteoarthritis, Pain

KALÇA OSTEOARTRİTLİ KÖPEKLERDE FİZYOTERAPİ- AĞRI, KAS VE TOPALLIK ÜZERİNE ETKİLER: RANDOMİZE KONTROLLÜ BİR ÇALIŞMA

ARAŞTIRMA MAKALESİ

ÖZ

Amaç: Çalışmamızın amacı kalça osteoartriti (OA) olan köpeklerde fizyoterapi programının etkinliğini incelemekti.

Yöntem: Kalça OA'sı olan 20 köpek dört haftalık çalışmaya dahil edildi. Köpekler rastgele olarak fizyoterapi grubu (PTG) ve kontrol grubu (CG) olarak iki gruba ayrıldı. PTG ve CG'deki köpeklerin kalça eklemine hyaluronik asit (HA) enjekte edildi. PTG'deki fizyoterapi programı masaj, elektrofiziksel modaliteler ve egzersizlerden oluşturuldu. Primer değerlendirmeler ağrı yoğunluğu, kas kütlesi ve topallama skorlarıydı. Ağrı değerlendirmesi Basit Ağrı Derecelendirme Skoru (0-4) ile yapıldı. Kas kütlesi uyluk çevresi ölçümleri kullanılarak, topallama ise özel bir skorlama sistemi (0-5) kullanılarak ölçüldü.

Sonuçlar: Çalışmanın sonunda, PTG'de ağrı (p=0,006) ve topallık skorları (p=0,005, p=0,006) azalmış ve kas kütlesi artmıştı (p=0,012). Ayrıca, gruplar arası karşılaştırmalar, tüm değişikliklerin CG'ye kıyasla PTG'de istatistiksel olarak daha fazla iyileştiğini göstermiştir (p=0,042, p=0,010, p=0,028, p=0,015).

Tartışma: Çalışmamızda kullanılan «HA + fizyoterapi» programının ağrıyı azaltmada ve kas kütlesini artırmada «tek başına HA"ya göre daha etkili olduğunu düşünüyoruz. Bu nedenle, fizyoterapi programlarının OA'lı köpeklerin tedavisinde faydalı ve güvenli olduğunu söyleyebiliriz. Fizyoterapi programları, özellikle hastalığın erken evrelerinden itibaren kas atrofisi ve topallık gelişimini önlemek için kullanılabilir.

Anahtar Kelimeler: Ağrı, Hayvanlarda Fizyoterapi, Kas, Köpek, Osteoartrit

INTRODUCTION

Osteoarthritis (OA) is a common disease that can significantly affect the welfare of dogs (1). Clinical manifestations of OA in dogs include reduced painless range of motion (ROM) in the affected synovial joints, decreased muscle flexibility, altered weight bearing of the affected limb when standing or moving, reduced performance in daily activities such as running, walking, jumping and climbing. Behavioural and reactionary changes are also seen in dogs with this disease. OA occurs most commonly in the hip, knee and elbow joints in dogs (2).

Pain and disability may not be associated with structural joint changes (such as joint space narrowing, osteophyte formation, bone sclerosis) that can be seen on radiography (3). Pain in OA may be caused by a variety of mechanisms. For example, mechanical stress with movement may cause pain in an OA joint. Recent studies suggest that neuroinflammation in the peripheral and central nervous systems plays a key role in chronic pain (4). OA is recognised as one of the leading causes of chronic pain in dogs, therefore it is a threat to health-related quality of life and animal welfare. Pain in dogs is defined as a subjective, unpleasant sensory and emotional experience. However, the inability of dogs to express their experiences in words makes it difficult to use scales to directly assess pain (5).

It is difficult for dog owners to report pain levels on a visual analogue scale (VAS). Pain associated with OA can manifest as behavioural changes in the dog. One of the most commonly used methods of assessing pain in dogs is gait analysis. In addition, visual assessment of movement and determination of the lameness degree may be used (6-7).

Another parameter closely related to pain is muscle mass and therefore muscle strength. A dog with hip pain cannot be expected to functionally use the affected area. This immobilisation will lead to loss of muscle mass and weakness over time. One study (8) in humans with hip OA analysed muscle strength and found strong evidence of generalised muscle weakness in the affected leg rather than localised hip muscle weakness. These differences in muscle strength and muscle mass may also occur because people with hip OA increase the load on the asymptomatic side to reduce the load on the symptomatic side. Cross-sectional studies have shown that generalised muscle weakness in the affected leg is present even in the early stages of OA (9), and that muscle strength and power are very important parameters in the diagnosis of OA. Based on the results of studies, it is hypothesised that an increase in muscle mass will lead to an increase in muscle strength, and stronger muscles will lead to improved functional performance (10). Therefore, exercise may be started early to prevent muscle weakness in patients with OA.

One of the methods used for pain management in the treatment of OA is HA application. It is thought that HA applied intra-articularly increases joint lubrication and leads to more painless movement (11).

Studies on the effectiveness of physiotherapy in the treatment of osteoarthritis in dogs are available in the literature (1). Physiotherapy methods are used in the treatment of OA in dogs, however, there is still no established protocol on this subject. Therefore, we aimed to investigate the effect of physiotherapy in OA dogs with this study.

We hypothesize that physiotherapy is effective in increasing muscle mass and reducing pain, and improvements in these parameters will lead to further improvements in functional performance. The aim of our study was to show that physiotherapy combined with HA provides more improvement than HA alone in dogs with OA.

METHODS

Design

The report follows the CONSORT guidelines for randomised trials of treatments.

Our study was conducted at the Near East University Animal Hospital between 2018-2020. This study was completed with two groups of dogs with OA randomly assigned (basic computer method) to receive four weeks of physiotherapy or not. The person who did the randomization and the people who performed the evaluation and treatments were different. The applications were performed by a physiotherapist with a certificate in animal physiotherapy. In the 20-subject study, pain intensity, muscle mass and lameness of dogs were evaluated at baseline and after 4 weeks. Since exercise programs in animals are generally revised at the end of 4 weeks in clinical practice, the program was planned for 4 weeks. The flow chart is given in Figure 1. Approval for this study was obtained from the Near East University Animal Experiments Local Ethics Committee (dated 26/09/2018 and decision number 2018/24-52). Written informed consent was obtained from the dog owners.

Participants

The severity of joint damage was evaluated by the veterinarian using the Kellgren-Lawrence scoring system (12). All dogs included were stage 2 or 3. The inclusion criteria for the study were diagnosis of hip OA on X-Ray by a veterinary surgeon, being older than 1 year and consent given by the volunteer dog owner.

Exclusion criteria; developed an acute health problem during the study, had undergone orthopaedic surgery in the previous 3 months and failed to comply with study/commands.

Clinical assessment

Pain severity was calculated using the Millis and Levine Simple Pain Rating Score (13). According to this scale (0-4), dogs were scored as follows: "0- no pain when the affected limb is palpated", "4- the affected limb cannot be palpated, the dog does not allow movement or physical touch".

Muscle mass was measured using an inflexible tape measure according to anthropometric protocols. The reference point (13) taken was ¼ of the proximal distance between the greater trochanter and the patella.

Lameness was scored using Millis and Levine's (0-5) scoring system. In the scoring system, '0' represents normal ambulation and '5' represents ambulation with any weight on the limb (13).

Interventions

The dogs were divided into physiotherapy group PTG (n=10) and control group CG (n=10). Dogs in the CG were injected with HA (Ostenil Plus 20 mg/ml) under sedation by the veterinarian on the first day. A dose of 5 mg was used in dogs weighing 10 kg or less, and a dose of 10 mg was used once in dogs weighing 11 kg or more. The dogs in the PTG in addition to the intra-articular application of HA, received a physiotherapy programme.

The physiotherapy programme consisted of massage, electrophysical modalities and exercises. At the beginning of the treatment, all dogs received 5 min of massage (stroking and kneading). Ultrasound (US) was applied for 5 min at an intensity of 1 watt/cm² and a frequency of 3.3 mHz, with the patient in the lateral recumbent position. After US, 70 Hz, 300 µsec, 20 min NMES and 15 min TENS at 100 Hz, 100 µsec duration were applied. All electrophysical applications were performed using Intelect® Vet Chattanooga.

After massage and electrical stimulation, exercises were performed by the physiotherapist (Table 1). Dogs in the PTG were treated 3 days a week for 4 weeks.

Statistical analysis and data reduction

The power analysis (G-power 3.1) was based on a similar study (14). It is based on the estimation that the study performed on 20 dogs with OA (10 dogs per group) will work at 95% confidence level and reach 85% power. Data were analysed with SPSS-21 package programme. Continuous variables were expressed as mean ± standard deviation and categorical variables were expressed as number and percentage. The independent samples t-test was used to compare two sample means, and Chi-square test was used for testing relationships on categorical variables. Mann Whitney U test was used for intergroup comparison of variables determined by counting. Wilcoxon test was used to compare independent group differences. In all analyses, $p<0.05$ was considered statistically significant.

Table 1. Exercise Program

Exercise	Procedure	0-2 weeks	2-4 weeks
ROM exercises	Hip joint, stifle joint, 10 reps	X	
Standing exercises	With 4 limbs, 3 min	X	
Weight-bearing	Dancing, three-leg standing, 3 min	X	X
Foam mattress walk	10 reps	X	X
Sit to stand exercises	20 reps		X
Exercise ball, wobble board	5 min		X
Gait training	Leash walking, 5 min		X
Stair activities	5 min		X

Table 2. Comparison of Demographic and Clinical Findings at the Beginning of Treatment

Variable	Physiotherapy Group	Control Group	p-value
Age (X±SD)	8.90±4.15	8.40±2.67	0.752+
BCS (X)	6	5	0.695++
Sex (%)	30 F 70 M	50 F 50 M	0.650+++

+Independent Sample T-Test, ++Mann Whitney U testi, +++Chi Square test, BCS: body condition score, X:mean, SD: standart deviation, p<0.05

RESULTS

Initially, 23 dogs were screened to identify 20 dogs for randomisation. Based on owner consent, all 10 dogs in the PTG received physiotherapy for 4 weeks and all assessments were completed on the first and last day of treatment. All dogs were fully compliant with the protocol and therefore data from all 20 dogs were included in the analysis.

The 10 dogs in the CG consisted of 5 females and 5 males. The dogs were aged between 5 and 13 years (median 8.40±2.67 years) and body condition scores (BCS) median was 5. The 10 dogs in PTG consisted of 3 females and 7 males. The dogs were aged between 2 and 14 years (median 8.90±4.15) and BCS median was 6 (Table 2).

Change in pain severity score

A comparison of the change in pain scores between the post-treatment groups is shown in Table-3.

According to this table, although the pain scores of both the PTG and CG decreased compared to baseline (p=0.006, p=0.083), the decrease in pain scores of the PTG compared to the CG was found to be statistically more significant in the between-group comparison (p=0.042).

Change in muscle mass

The comparison of the change in thigh circumference measurement between the groups after the programme is shown in Table 4. According to this table, the thigh circumference measurement increased in the PTG compared to the baseline

Table 3. Changes in the Pain Scores of the Groups

Pain (0-4)	Physiotherapy group				Control group				Mann Whitney U Test	
	Baseline	4 weeks	Wilcoxon test		Baseline	4 weeks	Wilcoxon test			
	Median (min-max)	Median (min-max)	Z	p	Median (min-max)	Median (min-max)	Z	p	Z	p
Pain	3 (1-3)	1 (1-2)	-2.739	0.006*	2 (1-3)	2 (1-3)	-1.732	0.083	-2.032	0.042*

Min: minimum, max: maximum, X: mean, SD: standard deviation, p<0.05: statistical error level, *Significant differences

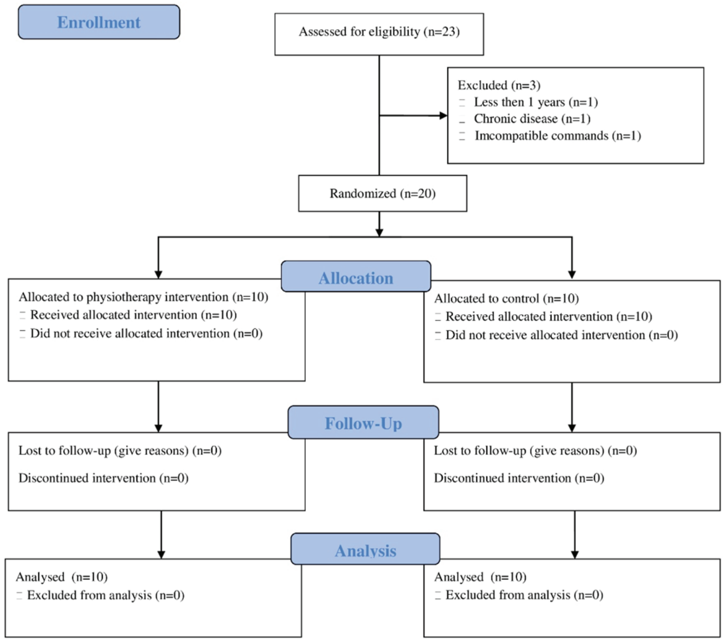

Figure 1. Flow Chart of the Study

results (p=0.012), whereas no change was observed in the CG (p=0.102). When comparing the groups, the thigh circumference measurements of the PTG were found to be statistically more significant than those of the CG (p=0.015).

Change in lameness scores

The comparison of the change in lameness score between the groups after the programme is shown in Table 5. According to this table, lameness decreased in the PTG compared to baseline

Table 4. Changes in Thigh Circumference Measurement of the Groups

Circumference measurement	Physiotherapy group				Control group				Mann Whitney U Test	
	Baseline	4 weeks	Wilcoxon test		Baseline	4 weeks	Wilcoxon test			
	X ±SD	X ±SD	Z	p	X ±SD	X ±SD	Z	p	Z	p
Thigh circumference (cm)	29.70±9.38	32.73±9.74	-2.510	0.012*	27.70±6.20	28.10±6.38	-1.633	0.102	-2.327	0.015*

Wilcoxon test, Mann Whitney U test, min: minimum, max: maximum, X: mean, SD: standard deviation, p<0.05: statistical error level, *Significant differences

Table 5. Comparison of Group Lameness Scores within and between Groups

Lamenes (0-5)	Physiotherapy group				Control group				Mann Whitney U Test	
	Baseline	4 weeks	Wilcoxon test		Baseline	4 weeks	Wilcoxon test			
	Median (min-max)	Median (min-max)	Z	p	Median (min-max)	Median (min-max)	Z	p	Z	p
Walk	3 (2-4)	2 (1-3)	-2.810	0.005*	3 (1-4)	2 (1-4)	-1.732	0.083	-2.646	0.010*
Trot	3 (3-4)	2 (1-3)	-2.739	0.006*	3 (2-4)	3 (2-4)	-1.732	0.083	-2.202	0.028*

Wilcoxon test, Mann Whitney U test, min: minimum, max: maximum, X: mean, SD: standard deviation, p<0.05: statistical error level, *Significant differences (p=0.005, p=0.006), whereas no change was observed in the control group (p=0.083, p=0.083). When comparing the groups, the lameness scores of the treatment group were statistically more significant than those of the CG (p=0.010, p=0.028).

DISCUSSION

Several studies have shown that intra-articular administration of HA is effective in modulating pain in dogs with OA (14-15). The general aim of physiotherapy in dogs with OA is to reduce pain, increase joint ROM and muscle strength to aid recovery. The aim of our study was to demonstrate the efficacy of physiotherapy combined with HA. And this trial showed that dogs with OA who received physiotherapy had greater reductions in pain and lameness and greater increases in muscle mass.

In our study, the average pain in dogs in the PTG was 3/4 at baseline, but decreased to 1/4 at the end of treatment. OA is the most common cause of chronic pain in dogs. The goal of pain management in OA is to provide adequate analgesia so that dogs can use their affected joints normally (16). This will minimise stiffness and muscle loss in the arthritic joint. In our study, in addition to HA, massage, TENS and US were used in the PTG to reduce pain. We hypothesise that the reduction in physical activity due to pain in dogs in the PTG was blocked by the analgesic effect of US therapy and TENS. Thus, US contributed to the reduction of pain in the dogs and thus to an increase in muscle mass.

Many studies in the literature emphasise the need to use exercise programmes to develop pain modulation and functional skills (17-18). A recent review (19) on the pain-relieving mechanism of exercise examined exercises of different duration, type, frequency and intensity. Researchers suggest that exercise regulates electrophysiological responses in the spinal cord, macrophage levels in the painful area and reduces pain by increasing anti-inflammatory cytokine synthesis (19). We believe that the exercises used in our treatment programme contribute to the modulation of pain. The exercises used reduced pain in the dogs both by regulating physiological responses and by increasing the dogs' physical activity and well-being. Vaz et al. (20) found in their study of patients with OA that NMES increased the thickness of the vastus lateralis muscle and the length of the fascicle, resulting in improved functional status. Electrical stimulation helps to increase muscle strength by inducing beneficial changes in muscle fibres and the capillary system. In this way, it allows the recovery of muscular atrophy due to inactivity. Melo Mde et al. (21) found that NMES statistically increased muscle fibre thickness and pennation angle values more than low-level laser treatment in patients with OA. Therefore, more force is released as a result of muscle contraction. The results of the study confirm that NMES administration is an effective strategy for improving OA-related muscle wasting. Increasing muscle mass and thus muscle strength will improve the functionality of the dogs.

According to the results of our study, we can say that the reduction in lameness scores is related to the reduction in pain and the increase in muscle strength achieved through exercise. The reduction in pain has an effect on the dog's gait and activity level.

There are articles showing that pain may be directly related to lameness (22). In his study, Brown et al. (23) showed that pain and lameness were directly related. Although there was no correlation between pain and lameness in the correlation analysis of our study (p>0.05), we believe that the reduction of pain is a parameter that will secondarily reduce lameness. Pain caused by stimulation of nociceptors (24) causes lameness. In a clinical setting, it is clear that most dogs with lameness experience pain. A study by Drygas et al. (25) showed that pain, lameness, swelling and joint restriction were all reduced within 24 hours in dogs treated with ice after TPLO surgery.

Similarly, the increase in muscle mass-strength will increase proprioception and receptor activity in affected limb. Therefore, it can be said that the amount of time the dog presses on the limb will increase and therefore the amount of lameness will decrease. Pellegrino et al. (26) investigated the effect of the 30 minutes of treadmill exercise on physical fitness and found that the dogs' thigh circumference measurements increased significantly at the end of 12 weeks. Thigh circumference measurements have a high correlation with muscle mass and have been used in studies to indirectly measure muscle mass (27). In our study, we found that there was a statistically significant increase in thigh circumference measurements in the PTG compared to the CG as a result of four weeks of NMES application and exercise training. No increase in thigh muscle mass was observed in the CG.

In the hip joint, all the stabilisers work to maintain joint kinematics. We know that stability is not normal kinematics and that kinematics is the key to normal joint health and function. While failure of any one stabiliser can lead to loss of normal kinematics and joint organ failure, failure of one stabiliser can be compensated for by others so that functional kinematics can be maintained (28). Muscle atrophy can be used as a clinical indicator to measure limb use. As the dog begins to use the limb normally, the strength of the thigh muscles increases (29,30). In their study, Fischer et al. (31), who investigated the relationship between muscle activity and gait, stated that kinetic and kinematic analyses that muscle activity produces more tissue response and joint loading increases muscle activity, joint stabilisation and muscle co-contraction.

The limitations of the study are that gait analysis could not be performed with objective methods and long-term effects of the treatment were not presented. We assume that the difference in the breeds of dogs does not affect the results of the study. Because all dogs were compatible with the exercises. However, in order to say anything clearly on this issue, the same study needs to be conducted on a single breed of dogs.

We think that the "HA + physiotherapy" programme used in our study was more effective than "HA alone" in reducing pain and increasing muscle mass. Therefore, we can say that physiotherapy programmes are beneficial and safe in the treatment of dogs with hip OA. Physiotherapy programmes can be used to prevent the development of muscle atrophy and lameness, especially from the early stages of the disease.

The results of this study are in line with other studies in the literature. And has shown that animal physiotherapy is an open and multidisciplinary field of science for clinicians and academicians working in both physiotherapy and veterinary medicine.

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Author Contributions*:* Concept – NA, EK; Design – NA, EK; Supervision – EK, FEÖ; Materials – NA; Data Collection and/or Processing – NA, SÇ; Analysis and/or Interpretation – NA, EK, FEÖ, SÇ; Literature Research – NA, EK; Writing Manuscript – NA, EK; Critical Review – EK, FEÖ.

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